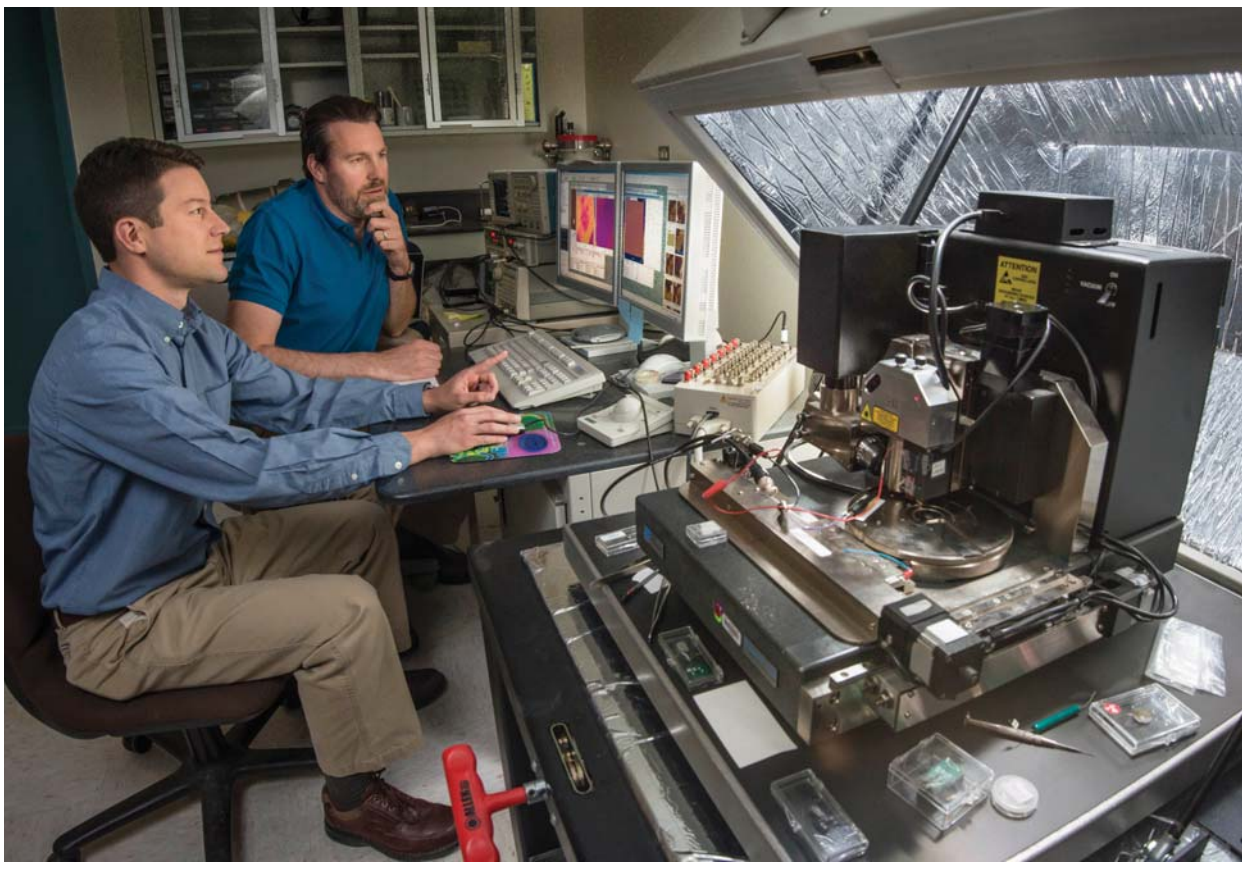
Phonons, arise!

Small electric voltage alters conductivity in key materials



By Neal Singer

Modern research has found no simple, inexpensive way to alter a material's thermal conductivity at room temperature.

That lack of control has made it hard to create new classes of devices that use phonons — the agents of thermal conductivity — rather than electrons or photons to harvest energy or transmit information. Phonons — atomic vibrations that can transport heat energy at up to the speed of sound in solids — have proved hard to harness.

Now, using only a 9-volt battery at room temperature, a team led by Jon Ihlefeld (1816) has altered the thermal conductivity of the widely used material PZT (lead zirconate titanate) by as much as 11 percent at subsecond time scales. They did it without resorting to expensive surgeries like changing the material's composition or forcing phase transitions to other states of matter.

PZT, either as a ceramic or a thin film, is used in a wide range of devices ranging from computer hard

(Continued on page 4)

RESEARCHERS Jon Ihlefeld (1816), left, and David Scrymgeour (1728) use an atomic-force microscope to examine changes in a material's phonon-scattering internal walls, before and after applying a voltage. The material scrutinized, PZT, has wide commercial uses. (Photo by Randy Montoya)

Thunderbird Awards

Sandia honors teens who have overcome adversity

• Story on page 12 •

Sandia LabNews

Vol. 66, No. 8 **May 1, 2015**

Managed by Sandia Corporation for the National Nuclear Security Administration

Sandia National Laboratories

Sandia hosts 25th international nuclear material protection course

ANNE HARRINGTON, NNSA's deputy administrator for Defense Nuclear Nonproliferation, addresses the media during welcoming ceremonies for the 25th International Training Course on the Physical Protection of Nuclear Material and Nuclear Facilities. Looking on are Sandia Labs Director Paul Hommert, left, and Denis Flory, deputy director general of the International Atomic Energy Agency and head of the agency's Department of Nuclear Safety and Security. (Photo by Randy Montoya)

By Lindsey Kibler

Sandia is playing host to 44 nuclear security students from 36 nations, who will return to their home countries well-versed in the latest techniques and technologies needed to protect nuclear materials.

Top officials from Sandia, NNSA, and the International Atomic Energy Agency (IAEA) welcomed the students to the 25th International Training Course (ITC) on the Physical Protection of Nuclear Material and Nuclear Facilities.

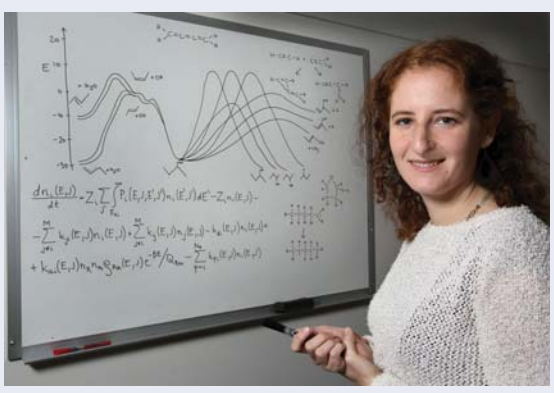
"Threats to nuclear materials and facilities often seem very abstract, but in this course we provide practical training that equips participants to implement the highest standards of nuclear security," Anne Harrington, NNSA deputy administrator for Defense Nuclear Nonproliferation, said at an April 20 news con-

(Continued on page 5)

Inside

KATHLEEN PIERSON, a systems engineer at Sandia's centrifuge facility, and grandson Logan Pierson hold a 1960 photograph of Kathleen's father and Logan's great-grandfather, Robert Ault, who was supervisor of the facility for many years during the height of the Cold War. Logan was visiting Sandia as part of Take Our Daughters and Sons to Work Day on April 23. For more photos and information about TODSTWD, see **page 7.** (Photo by Randy Montoya)

and . . .



KINBOT: A new tool for studying combustion. See **page 3.**

That's that

Is this a loopy idea, or what? Billionaire entrepreneur and visionary Elon Musk has lent his name to efforts to build a so-called "hyperloop" transport network that would make bullet trains seem so 20th century.

In simplest terms, the hyperloop is a train-like vehicle that races through a sealed tube, either elevated or underground.

When Musk introduced the hyperloop concept back in 2012, he called it a "fifth mode of transportation" and described it as a "cross between a Concorde, a railgun, and an air hockey table."

Hyperloop shares some characteristics with vacuum tube and magnetic levitation (maglev) proposals that have been around for decades, but it avoids some of the pitfalls of those designs: Maglev systems are voracious energy hogs and maintaining a pure vacuum over extended distances is a daunting challenge. As such, despite their technical feasibility, the cost of such systems has been prohibitive for most prospective participants.

Apparently, in the hyperloop concept championed by Musk, a pod would move on a cushion of air inside a steel tube – thus the comparison to air hockey – and would whisk you from Los Angeles to San Francisco in 30 minutes.

Musk, who made his fortune as the cofounder of PayPal, has a reputation of putting his money where his mouth is. He didn't retire to the beach when his ship came in; he's boldly put his wealth to work in arenas where less nervy entrepreneurs have feared to tread. He's been successful in endeavors – Tesla and SpaceX – where the skeptics have said there's no room for new kids on the block. The point is, when Musk starts talking about a new mode of transportation, you have to take him seriously.

It didn't take the naysayers long to point out all the reasons why the hyperloop concept "can't" work. The objections have come from every quarter: The cost estimates are wildly understated; the politics of the proposal will make it impossible to get right-of-way approval; the concept underestimates the engineering challenges; and the human factors have not been adequately considered and accommodated.

I don't think Musk is daunted by these concerns. He's building a five-mile-long test track in Texas and has made the entire design open-source, inviting the best engineering minds on the planet to help refine the hyperloop concept into something viable. I hope he succeeds. Given his track record, I'd bet on it.

* * *

Thinking about the hyperloop, I had a Walter Mitty-esque moment: Imagine that it's early in the conceptual stage. One of Musk's out-of-the-box engineers says it would be fun to add some excitement to what would otherwise be a plain vanilla passenger experience. He proposes that every few miles the system incorporate a big vertical loop like you'd see on a Hot Wheels racetrack. He calls it the hyperloop de loop. Musk's team convinces him the idea is not just out of the box but off the wall. Maybe so, but reportedly Six Flags Over Texas is interested. (Just kidding here, folks.)

* * *

One of the appeals for me of the hyperloop is that evokes visions of the future – not the *real* future, but the world of tomorrow as depicted on the cover of *Popular Science* in the 1940s and '50s, a future of flying cars, gleaming towers, and pencil-thin spaceships landing gracefully at the edge of the city. Inspired by these magazine images, I have a bad case of retrofuturism, nostalgia for a future that never was.

As a kid, I loved time-travel stories. I used to fantasize about what I'd do if I had a time machine and a one-way ticket: Would I go back or forward? I gobbled up ancient history as a kid – couldn't read enough about ancient Egypt and Rome and Greece. I almost ached to know what it was really like to live on the Nile and see the pyramids actually being built or watch a triumphal parade of a conquering Roman general. So the past had its appeal. But for me, it was the future that really beckoned. If I had to choose one or the other, I would fast forward several hundred years to find out if we got to the stars.

Today, my ambitions in this regard are more modest and personal. I'd go back, after all, back to the very first time my wife-to-be and I spent a whole day together. And this time, I'd try not to spill the iced tea in her lap at the Perkins Cake and Steak restaurant that straddled Rattlesnake Creek in Missoula.

See you next time.

– Bill Murphy (MS 1468, 505-845-0845, wtmurph@sandia.gov)

Materials engineer joins New Mexico's elite **Forty Under 40**

By Nancy Salem

Jon Madison says being named one of the state's top young professionals reflects on Sandia's role in the community. "This award speaks to the impact so many scientists, staff, and personnel at the Laboratories have on the city day in and day out, every week, month, and year," he says. "It's a real honor."

Jon (1851) was chosen for the 2015 class of *Albuquerque Business First's* Forty Under 40, which recognizes young people who stand out professionally and in the community.

JON MADISON (1814) says being named to the Forty Under 40 is inspiring. "It's great to be counted among a group of fellow citizens who have made the decision to use whatever power they have to impact their immediate environment and our fair city in such a positive and definitive way," he says.

Earlier this year, Jon was named winner of a Black Engineer of the Year Award (BEYA) for Most Promising Scientist. "I guess this is my year," Jon laughs. "I was excited to be recognized nationally and locally and to represent Sandia in this way."

Jon is a Kansas native who decided as a teen that he wanted a career in science. "My parents were painting contractors, and they didn't push me into any one field or direction," he says. "They said whatever you do, do your best, and that stuck with me."

Jon went to Clark Atlanta University, a historically black university, where he earned a bachelor's degree in engineering science. He then headed to the University of Michigan to complete his master's and doctorate in materials science and engineering.

Jon was in the Louis Stokes Alliance for Minority Participation (AMP) initiative, a STEM scholarship program of the National Science Foundation. "They said from day one that I would go to grad school," he says. "The expectations were high."

He did summer internships at the Naval Research Laboratory in Washington, D.C., Washington State University, and the Massachusetts Institute of Technology. "I was looking for mechanical engineering internships but ended up in materials research programs," he says.

Jon joined Sandia in 2010 after completing his dissertation. "I talked to many of the labs but Sandia was always the frontrunner," he says.

Jon's work centers on destructive and non-destructive techniques to understand microstructure in three dimensions, and using that information in experiments and simulations. He's also helping to develop a materials database that can be used across the Labs.

Jon is an Executive Fellowship mentor and works with interns from around the country. "I take mentoring really seriously," he says. "It is our responsibility as scientists to mentor the next generation. It's close to my heart because I was groomed by mentors."

He and his wife volunteer with Big Brothers Big Sisters of Central New Mexico. And Jon is a life member of the National Society of Black Engineers and the NAACP. He is also area director of Alpha Phi Alpha Fraternity Inc., which had Dr. Martin Luther King Jr. as a member.

Jon's manager, Anton Sumali of Materials Mechanics & Tribology Dept. 1851, says Jon is "always very professional, respectful, and effective."

"He's not only an excellent engineer and researcher; he manages projects very well," Anton says. "He's a great communicator."

Jon's message to young people is to aim high and strive for the best. "You never know what opportunities are around the corner," he says.

Sandia LabNews

Sandia National Laboratories

Sandia National Laboratories

http://www.sandia.gov/LabNews

Albuquerque, New Mexico 87185-1468
Livermore, California 94550-0969
Tonopah, Nevada • Nevada National Security Site
Amarillo, Texas • Carlsbad, New Mexico • Washington, D.C.

Sandia National Laboratories is a multiprogram laboratory operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corp., for the US Department of Energy's National Nuclear Security Administration.

Bill Murphy, Editor **505/845-0845**
Randy Montoya, Photographer **505/844-5605**
Patti Koning, California site contact **925/294-4911**
Michael Lanigan, Production **505/844-2297**

Contributors: Michelle Fleming (Ads, Milepost photos, 844-4902), Neal Singer (845-7078), Patti Koning (925-294-4911), Stephanie Holinka (284-9227), Darrick Hurst (844-8009), Heather Clark (844-3511), Sue Holmes (844-6362), Nancy Salem (844-2739), Tim Deshler (844-2502), Valerie Larkin (284-7879), Lindsey Kibler (844-7988), Rebecca Brock (844-7772), Valerie Smith, manager (844-6167)

Lab News fax **505/844-0645**
Classified ads **505/844-4902**

Published on alternate Fridays by Internal & Digital Communications Dept. 3651, MS 1468

LOCKHEED MARTIN

Lab News Reader Service

The *Sandia Lab News* is distributed in-house to all Sandia employees and on-site contractors and mailed to all Sandia retirees. It is also mailed to individuals in industry, government, academia, nonprofit organizations, media, and private life who request it.

Retirees (only):

To notify of changes in address, contact Benefits Dept. 3332, Customer Service, at 505-844-4237, or Mail Stop 1021, Sandia National Laboratories, Albuquerque, NM 87185-1021.

Others:

To receive the *Lab News* or to change the address (except retirees), contact Michelle Fleming, Media Relations and Communications Dept. 3651, 505-844-4902, email meflemi@sandia.gov, or Mail Stop 0165, Sandia National Laboratories, Albuquerque, NM 87185-0165.

Employees:

To address concerns regarding delivery of the *Lab News* to your facility, call Mail Services Team 10268-4, at 844-3796. At Sandia/California contact the Mail Room at 925-294-2427.

Web users:

The *Lab News* is on the external web at www.sandia.gov/LabNews. *Lab News Interactive*, accessible on the internal web, is at: www-irn.sandia.gov/newscenter/interactive.

KinBot

A tool to accelerate chemical descriptions of combustion

By Holly Larsen

Faced with the time-consuming and tedious task of characterizing the myriad reactions in a combustion process at the molecular level, Judit Zádor (8353) turned to computers — an understandable choice, given her role as a computational physical chemist at Sandia's Combustion Research Facility (CRF). Her solution, a code called KinBot, has demonstrated it can predict the behavior of potential reactions in combustion for a given molecule. The key is KinBot's ability to identify viable 3-D structures for critical intermediate species on the pathway between reactants and products.

With KinBot, combustion scientists can more quickly predict the speed of reactions, expressed as rate coefficients. This knowledge brings the community closer to the goal of understanding and predicting the combustion process using either conventional fuels or new fuels that can reduce pollutants, greenhouse gas emissions, and dependence on petroleum.

A puzzle with too many pieces

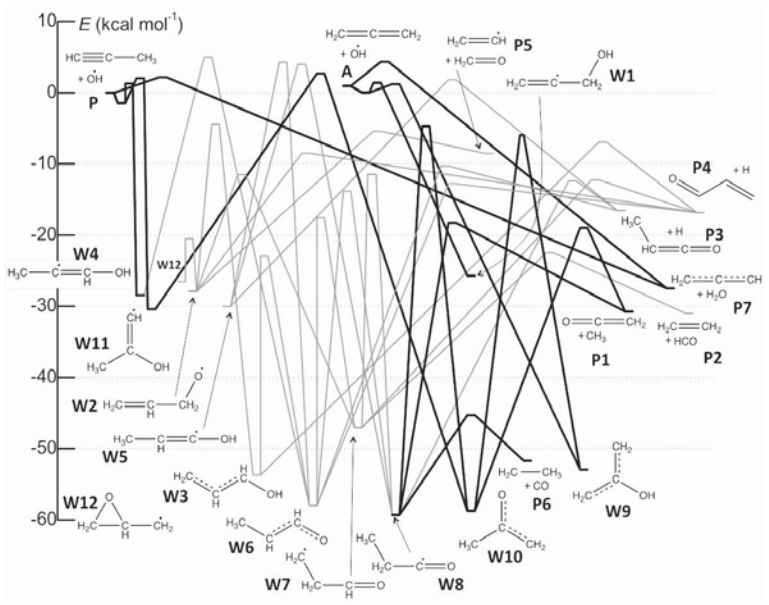
Identifying the rates at which relevant reactions take place is a challenge for scientists who want to understand combustion. A fundamental problem is the sheer number of reactions — possibly in the thousands — involved in the combustion of even a single-component fuel. Typical fuels may comprise hundreds of chemical components, so even managing the pieces of the puzzle is difficult.

Chemists have developed software to keep a running list of potential reactions during combustion. But today's software is a partial solution. Judit says, "We also need to calculate the parameters that characterize these reactions. We need to know the branching to create each molecule in a reaction and the corresponding rate coefficients. To calculate these properties, we need to know the 3-D structure of the intermediates for the reaction in question."

The connections and arrangements in space of a molecule's atoms determine its key properties, such as energy and vibrational frequencies. These properties govern the rate at which molecules turn into one another. For instance, the greater the energy of a transition state connecting two stable intermediates, the slower the transformation of one intermediate into the other.

Teasing out this information for a single reaction can take months because a single reaction often has many pathways associated with several structures. Judit uses Legos to explain. "Starting with just a few blocks, you can make a surprisingly large number of arrangements, and it is daunting to try to make all possible configurations. A molecule can stretch out, curl up, or take many forms between these extremes; this ensemble of shapes determines the molecule's reactivity on a macroscopic level. Many times we have to deal with dozens of shapes — we call them conformers — for each chemical species involved. It's a lot of work!"

JUDIT ZÁDOR'S KINBOT code looks for 3-D structures in chemical reactions to quickly make predictions about behavior of potential reactions in combustion for a given molecule. With these predictions, scientists can identify the rates at which relevant reactions take place, information that is critical to understanding combustion. (Photo by Dino Vournas)



APPLYING RULES that replicate human intuition, KinBot explored these structures and their connections for the OH + allene and OH + propyne reactions.

Despite their advantages — speed, absence of errors, and incapacity for boredom — computers lack the intuition possessed by human chemists. Without intuition, even computers cannot characterize combustion reactions in a reasonable amount of computation time.

Working with Habib Najm (8351) and supported by an Early Career Laboratory Directed Research and Development grant, Judit generated a series of generic, minimalist rules that crystalize a century of knowledge. Validated by experiments and theory, these rules enable computers to proceed like a chemist.

Judit explains, "KinBot first analyzes a structure and makes conclusions just as a human would: this is a radical structure or this is a cyclic structure, for instance. Then KinBot applies rules to break and make bonds and morphs the structures into shapes that are very close to the critical transition states for these processes." The resulting geometries are sent to an electronic-structure code for refinement.

KinBot repeats the process for all possible pathways and configurations in a reaction. Some pathways can be dismissed because they require too much energy. But, says Judit, "You have to know all the pathways to identify the lowest-energy pathway. So it's helpful to have a code that rapidly scans and proposes a large number of possibilities." These options are then screened by KinBot's rules to keep the number of proposed structures within the bounds of practicality.

The unexpected virtue of inexperience

Given the realities of time and funding, researchers often limit their searches to the pathways shown to be probable by their experience and experimental knowledge. Moreover, because chemists typically focus on a single molecule or molecule type, they may develop tunnel vision and overlook — or never hear about — reactions found in another molecule.

In contrast, KinBot's rules are assembled from the work of many researchers, and demonstrates the virtue of inexperience. "KinBot might find that rules for carbonate also apply to ether-type molecules and uncover pathways that would otherwise be overlooked," says Judit. KinBot may stumble upon exotic structures (e.g., a high-energy but stable structure with an unusual trivalent oxygen atom), put new twists on known reaction steps, or simply combine simple steps in an unexpected way.

KinBot's rules imperfectly reflect reality; however, Judit is unfazed by this gap. "When I see a result that doesn't fit the rules, I know that I need to think about that result more." A recent example is KinBot's discovery of a water-elimination pathway in alcohol combustion. Solving the problem underlying this pathway required sophisticated electronic-structure calculations; the results were later presented in a high-profile publication.

"Chemists like working on tough problems. We're happy to let KinBot handle the routine work, so we have time to concentrate on the problems that require creative thinking," says Judit.

Further KinBot development

KinBot is off to a strong start. It has been tested by Oliver Welz, a former CRF postdoc who now heads a chemical kinetics research group at the University of Duisburg-Essen in Germany, and a paper on KinBot garnered Judit the Distinguished Paper award in Reaction Kinetics at the 35th International Symposium on Combustion last summer.

This summer, Ruben van de Vijver will use KinBot to find missing parameters for chemical mechanisms developed at Belgium's Ghent University. The results will help Judit improve KinBot's code to encompass more molecules.

Xiaohu Li (8353), a CRF postdoc working with Judit, has proposed extending KinBot's capabilities by incorporating molecular-dynamics simulations. Although these calculations are significantly more time-consuming than the present approach, they require far fewer assumptions.

"We hope that if we combine the current rule-based strategy with molecular dynamics in a clever way, we are going to be ahead of the game. But this is yet to be seen," says Judit.

Sandia CaliforniaNews

Sandians honored

for technical accomplishments, business support

B2B matchmaking savvy brings Sandian Ann Riley national recognition

By Nancy Salem

Ann Riley had an idea to bring government contractors together with women entrepreneurs and see if business happened. It did.

The first matchmaking event, in the fall of 2013, included eight major government contracting corporations, such as Lockheed Martin and Raytheon, and about 100 New Mexico woman-owned businesses. Ann (10222) also invited representatives from such community resources as chambers of commerce, the US Small Business Administration, the Women's Economic Self Sufficiency Team, and SCORE. "It's a business-to-business event. The women had an opportunity to meet each other and do business with government contractors," Ann says. "It was a big success."

ANN RILEY

A second event was held last year and a third is scheduled Oct. 15 at the Albuquerque Marriott.

Ann's efforts were recognized recently when she was named one of the country's Top 100 Leaders in Supplier Diversity by *WE USA* magazine, which focuses on women's business enterprise and diversity. The honorees were chosen for their commitment to provide a more diverse and inclusive supply chain and for their outreach and involvement.

"I was so shocked I didn't know what to say," Ann says. "It's fabulous. I was so honored."

Sandia partners on the event with Women's Business Council Southwest, which is the regional council for Women's Business Enterprise National Council, or WBENC. "The goal is to bring more business to companies already doing government contracting," Ann says. "But there are also people there who are new to that work."

She says one-on-one conversations are a hallmark of the event along with attendance by representatives of the state's congressional delegation. "They are there to assist and meet the women and see what their needs are," Ann says. "They talk about barriers and how they can help."

Ann, a 33-year veteran of the Labs, has worked in the Small Business Utilization Department for about 15 years and has been woman-owned small business advocate for seven years. She says the matchmaking event supports Sandia's small business procurement goals.

"Sandia has a long-term commitment to small businesses including woman-owned small business and other economically disadvantaged small business categories," says Krista Smith, senior manager of Policy, Assurance & Outreach Dept. 10220. "We are pleased that Ann was recognized with this award as an acknowledgement of her dedication and advocacy."

Don Devoti, Ann's manager, says her career "has been one of dedication and service to others."

"Her passion, commitment, and zeal as a small business advocate working in support of local, regional, and national small business suppliers has been unsurpassed," he says. "Her enthusiasm is contagious."

Ann says she hopes to make the event better every year. "Each time we learn a lot about things we can do better. We fine tune it," she says. "All the organizations come together to support woman-owned small business being successful in contracting with the government."

Bill Stygar receives IEEE Nuclear and Plasma Science Society's Erwin Marx award

By Neal Singer

Bill Stygar, manager of Sandia's Advanced Accelerator Physics Dept.1651, has been selected to receive the Erwin Marx award by the Pulsed Power Science and Technology Committee of the IEEE Nuclear and Plasma Science Society.

The award's previous recipients "are a who's who of the leaders in pulsed power science and technology," said Duane Dimos, former director of Sandia's pulsed power sciences center (1600). "Please join me in congratulating Bill on this recognition of a long history of outstanding work and accomplishments in pulsed power science and technology."

Says Bill, "I'm completely humbled by the award, and hope I can live up to it."

Erwin Otto Marx was a German electrical engineer who in 1924 invented the Marx generator, a device for producing high-voltage electrical pulses that power huge machines like Sandia's Z accelerator.

The award includes an invitation to give a plenary presentation in early June at the 20th IEEE Pulsed Power Conference in Austin, Texas.

In addition to publishing many highly cited technical papers, Bill was praised by the selection committee as contributing "more than any single individual to the successful operation of [Sandia's Z] facilities at peak electrical powers and peak reliability over the period of 1996-2014."

BILL STYGAR

In addition, "he was the principal designer for the vacuum power flow section of the Z and ZR facility, the world's most powerful laboratory pulsed-power generator. . . . His pulsed power research efforts over the last 33 years culminated in his invention of a new petawatt-class pulsed-power-accelerator architecture, which has been patented and is highly cited."

ZR is the formal name given to a renovation of the Z machine, completed in 2007, which increased its current from 18 million to 27 million amperes.

Additionally, Bill has made "seminal contributions to the physics and technology of superpower pulsed-power generators and to the realization of the Z and ZR accelerators as precision scientific instruments, contributing to a revolution in pulsed-power-driven high-energy-density-physics experiments."

Says Bill, "I feel in fact that the award actually belongs to the talented teams of world-class colleagues with whom I've been extremely fortunate to serve.

"I've also been extremely fortunate to have had visionary, brilliant, and supportive technical managers, such as Mike Cuneo, Ray Leeper, John Porter, and Rick Spielman.

"In addition, I'd very much like to thank Keith Matzen, Dillon McDaniel, John Porter, and Rick Spielman for leading the international Z-pinch program for three decades, and giving me — and hundreds of other scientists — the opportunity to do challenging and critical work in the service of national security."

Phonons

(Continued from page 1)

drives, push-button sparkers for barbecue grills, speed-pass transponders at highway toll booths, and many microelectromechanical (MEMs) designs.

"We can alter PZT's thermal conductivity over a broad temperature range, rather than only at the cryogenic temperatures achieved by other research groups," Jon says. "And we can do it reversibly: When we release our voltage, the thermal conductivity returns to its original value."

The work was performed on materials with closely spaced internal interfaces — so-called domain walls — unavailable in earlier decades. The close spacing allows better control of the passage of phonons.

"We showed that we can prepare crystalline materials with interfaces that can be altered with an electric field. Because these interfaces scatter phonons," says Jon, "by simply changing their concentration, we can actively change a material's thermal conductivity. We feel this groundbreaking work will advance the field of phononics."

The researchers, supported by Sandia's Laboratory Directed Research and Development office, the Air Force Office of Scientific Research (FA9550-13-1-0067), and the National Science Foundation (CBET-1339436), used a scanning electron microscope and an atomic force microscope to observe how the domain walls of subsections of the material changed in length and shape under the influence of an electrical voltage. It is this change that controllably altered the transport of phonons within the material.

"The real achievement in our work," says Jon, "is that we've demonstrated a means to control the amount of heat passing through a material at room temperature by simply applying a voltage across it. We've shown that we can actively regulate how well heat — phonons — conducts through the material."

Jon points out that active control of electron and photon transport has led to technologies that are taken for granted today in computing, global communications, and other fields.

"Before the ability to control these particles and waves existed, it was probably difficult even to dream of technologies involving electronic computers and lasers," he says. "And prior to our demonstration of a solid-state, fast, room-temperature means to alter thermal conductivity, analogous means to control the transport of phonons have not existed. We believe that our result will enable new technologies where controlling phonons is necessary."

The work, published last month in *Nano Letters*, was coauthored by David A. Scrymgeour (1728), Joseph R. Michael (1800), Bonnie B. McKenzie (1819), and Douglas L. Medlin (8341); Brian M. Foley and Patrick E. Hopkins from the University of Virginia; and Margeaux Wallace and Susan Trolier-McKinstry from Penn State University.

The goal of future work is to better understand "what caused this effect to happen so efficiently," Jon says.

DENIS FLORY AND ANNE HARRINGTON examine sensors used in detecting the failure of nuclear reactors at Sandia's Training and Technology Demonstration Area, inside the Center for Global Security and Cooperation (CGSC), during a tour with Dept. 6230 senior manager Susan Pickering. Flory and Harrington toured the CGSC as part of the welcoming ceremony for the 25th International Training Course on the Physical Protection of Nuclear Material and Nuclear Facilities. (Photo by Randy Montoya)

25th ITC

(Continued from page 1)

ference on the opening day of the course.

Every 18 months for the past 37 years, Sandia has hosted the ITC, and so far has trained more than 800 people from 73 countries. This year's course will conclude May 8.

Denis Flory, deputy director general and head of the IAEA Department of Nuclear Safety and Security, said the course is one of the most respected in the world. "It enables partnerships to initiate and operate proper physical security in their respective countries — in line with global regulations and recommendations — and to take part in a global effort to strengthen nuclear securities," he said.

When Congress passed the Nuclear Non-Proliferation Act in 1978, it directed DOE to provide training in physical security techniques and technology to security specialists from the now 164 states that are members of the IAEA. DOE selected Sandia to fulfill the directive.

"This course showcases the unique partnership we have had for 37 years. Sandia offers the very best expertise in world in this subject," said Harrington.

Harrington said the hands-on approach by instructors and practitioners in the field not only provides technical experience the students may not have, but helps to build connections between members in the program.

"[Sandia and our partners] are long-standing practitioners in the research, development, implementation, and refurbishment of physical security systems," said Div. 6000 VP Jill Hruby, who was joined at the event by Sandia President and Laboratories Director Paul Hommert. "Our collective goal in providing this course is to assist member states in the protection of nuclear materials across the life cycle, to include use, production, storage, transportation, and disposition."

"Through this program, Sandia supports the NNSA and the IAEA so, together, we can achieve a goal we all share" in the physical protection of nuclear materials and facilities, Paul said.

Course has evolved over time

Since its inception, the course has evolved to reflect industry best practices and up-to-date physical protection technologies. The original guidelines for IAEA member states to use in establishing, implementing, and maintaining their national nuclear security regime was published in June 1977, Harrington noted.

"We now live in a world that changes at an astonishing speed compared to 1978. So, very appropriately, the guidelines that we apply to physical protection must change with the times as well," she said.

The guidelines now offer a graded approach to protection, taking into account the assessed threat and potential consequences related to physical protection, and incorporating cybersecurity guidance.

"It is important that we not lose sight of the fact that cyber threats affect our work as well. In fact, a cybersecurity incident could lead to the theft of nuclear material, a catastrophic sabotage of a nuclear facility, or the falsification of safeguards information," Harrington said.

ITC training focuses on a systems engineering, performance-based approach to requirements definition, design, and evaluation for physical protection systems. Participants learn a methodology for designing and evaluating physical protection systems for nuclear facilities and materials that are effective against the threats of radiological sabotage and theft.

"A strong security culture can only be built if the most senior people in the management pyramid are fully committed and demonstrate that commitment in meaningful ways," Harrington said. "From my perspective, working with the IAEA to conduct the ITC is one of the most important contributions that NNSA makes to promoting the highest standards of nuclear security."

Steve Ortiz marks retirement with 25th ITC

For Steve Ortiz , manager of International Physical Security Dept. 6833, the 25th International Training Course (ITC) on the Physical Protection of Nuclear Material and Nuclear Facilities marks the close of a more than 35-year career at Sandia.

Steve joined the Labs in February 1980 and shortly after was assigned as a subject matter expert for the fifth iteration of ITC. He served as a small group instructor for ITC 6.

STEVE ORTIZ

"Probably the most memorable ITC for me was ITC 6. This was my first real exposure to working with the international community. I was able to share some of this experience with my family through some of the social events connected to ITC," says Steve.

He also served as the director for ITC 14, 23, 24, and most recently, 25. Directing this year's course meant Steve would have to extend his retirement to stay on board — something his senior manager, Pablo Garcia (6830), says is telling of his commitment and selfless service to Sandia.

"Steve is a recognized authority worldwide on physical security. Under his leadership, the ITC training has continued to improve, stay relevant to current threat, and take advantage of capabilities and know-how across Sandia," says Pablo.

Since serving as director, Steve has implemented changes to the course's materials and delivery.

"In the last three years where I have been director of the ITC we have made progress in connecting the course closer to the recommendations in IAEA'S Nuclear Security Recommendation on Physical Protection of Nuclear Material and Nuclear Facilities. The material has always been relevant to this IAEA document but we have tried to make it clearer as to how this class will help them design security systems to meet the recommendations," Steve says.

In addition, Steve pushed for new technologies, which saved time and money and put a wealth of information at the students' fingertips.

Under Steve's leadership, Pablo says, "the class is now more interactive, with many small group exercises. ITC-24 saw the first use of mobile tablets, which replaced the pounds of pre-printed materials, which allowed access to hotel wireless networks and the availability to get open-source information on commercially available sensors."

This year, ITC students are using tablets during classroom exercises and all materials are made available online once they successfully complete the course.

"The person leading ITC-26 18 months from now will be able to take full advantage of what Steve has set in motion," says Pablo.

For Steve, the course's success is due to the contributions Sandia as a whole has made to the international nuclear security community.

"I believe the international work Sandia conducts in helping build human capacity in all areas of physical security of nuclear materials and facilities has a huge impact in making the United States and world safer," says Steve.

Following his retirement, Steve says he hopes the ITC "continues to provide NNSA and IAEA with the same exceptional level of Sandia subject matter expertise in nuclear security they have received for the last 37 years."

Caught in the act

Sandia helps local security company thwart thieves

By Nancy Salem

DAVE MEURER, left, of Armed Response Team, and Dave Furgal (6831) go over the technology used to protect an Albuquerque nursery from thefts of landscaping materials stored outside. "We developed a whole new market niche and a unique competitive position," Meurer says of working with Sandia on security systems. (Photo by Randy Montoya)

At a motorcycle shop on a busy Albuquerque street, thieves devised an elaborate scheme to steal from the storage yard. They jumped the fence and unpacked some newly arrived bikes from crates. They used the crates to build a ramp and run the motorcycles over and out.

"The owner called and said 'What can I do? I have a big yard. How do I stop this?'" says Dave Meurer, CEO of the Albuquerque security company Armed Response Team.

The businessman wanted something elusive in the security industry: outdoor monitoring that catches burglars without a bunch of false alarms. Typical outdoor perimeter systems use motion and beam sensors that have trouble distinguishing, say, a tumbleweed, plastic bag, or cat from a person. "Everything trips the alarm because the outdoor environment cannot be controlled," Meurer says. "Indoor motion sensors manage what is going on. Outside, a windy day, rain, or anything else unexpected trips sensors continuously. It just didn't work."

Armed Response, a small company founded in 2004 by former city cops, was building a clientele of business and home owners. But Meurer saw a huge underserved and untapped market for reliable protection of outdoor spaces. "One of the major unmet needs for security involves places like storage yards, construction sites, and areas where companies park trucks at night," Meurer says. "Tools get stolen, fuel gets siphoned off, building materials disappear. When crews show up their stuff is gone and they can't work. The security industry didn't have good solutions for that problem."

Meurer knew Armed Response could gain a competitive advantage by figuring it out. "We knew there was a way to do it. We just didn't know what it was," he says. "We were a young startup. Cash was tight. We didn't have the resources to find the answer."

Armed Response in 2007 approached the New Mexico Small Business Assistance (NMSBA) program, which pairs entrepreneurs who need technical help with scientists and engineers at Sandia and Los Alamos national laboratories.

Turns out that Sandia has a long history — dating back to the 1970s — of testing physical security sensor and video technologies.

> *"Our company has been enhanced by our involvement with NMSBA and Sandia."*
>
> **— Dave Meurer, Armed Response Team**

"We got word that NMSBA was looking for somebody who knew about video analytics for security. I had been testing those systems for the government for years," says Dave Furgal (6831). "I said to NMSBA, 'You found the one person at Sandia who probably knows the most about that technology.' We knew what worked and how it worked."

Changes in pixels catch the computer eye

The two Daves met and, through NMSBA, worked together to configure and test a reliable, affordable outdoor security system that helped Armed Response more than triple its staff and clientele. "Luckily for us, Dave had done a lot of the development testing and vetting of what works," Meurer says. "We were a small business clawing toward profitability. R&D money? What's that? For us, cost is the name of the game. We used Sandia's expertise to more efficiently and rapidly move into the marketplace without having to guess at our options. It dramatically shortened the learning curve."

Video content analytics is used in a wide range of domains including entertainment, health-care, retail, automotive, transport, home automation, safety, and security. Furgal recognized immediately that the technology would be a key component of the solution for Armed Response's needs.

"It begins by looking at changes in pixels in successive frames of video. The algorithms identify a group of pixels moving in the same direction with purpose, as opposed to a tree that moves back and forth," Furgal says.

The technology puts a colored box around the pixels and sends it with an alert to a central alarm station where an operator can watch it, decide if it is friend or foe, and dispatch a security officer if necessary. "Does it look like a human? Does it look like a vehicle?" Furgal says. "The operator doesn't have to watch a mind-numbing surveillance camera live feed to detect an intruder. The colored box focuses the operator's attention on where to look in the video scene and weeds out extraneous video that doesn't matter."

Sandia tested the systems at a site in Tech Area III in mock perimeters, letting them run for months to observe their behaviors. Then researchers tried to trick them with flying objects to mimic such things as birds, plastic grocery bags, and tumbleweeds, and simulate wind, rain, and snow. They tried to outsmart them by walking slowly or crawling, and moving in the lowest possible light.

Furgal's involvement with Armed Response was primarily advisory. Because of his knowledge of the many security system options available in the marketplace, he was able to evaluate Armed Response's specific requirements and recommend a suite of commercial off the shelf hardware and software systems that would do the job for them.

"Each vendor's technology has behaviors of its own," Furgal says. "You have to collect data on the performance of each system, and observe those behaviors for many months to collect detection and false alarm statistics. A small business doesn't have the time and resources to do that."

Scientific knowledge leads to innovative solutions

Armed Response, which is now monitoring about 75 sites, has requested NMSBA help a couple of times, working with Furgal on video and physical security technology. "Every time without fail Dave has contributed to our ability to more effectively serve our clients and expand our customer base," Meurer says. "We developed a whole new market niche and a unique competitive position."

Furgal says he enjoyed working with the Armed Response entrepreneurs. "You get a sense of personal satisfaction helping a fledgling company that really doesn't understand the operational attributes of the technology they're trying to deploy," says Furgal, who worked for a startup early in his career. "I understand when you're a new business short on staff you can use all the help you can get. In their world, they need to make money selling a service. They have to be effective, efficient, and not cost prohibitive. It makes you think about technology implementation in a whole different way."

The state-funded NMSBA was established in 2000 by the New Mexico Legislature to help small businesses get technical support from the labs. It has provided $43.7 million in assistance to 2,341 companies in 33 counties, resulting in $200 million in increased revenue and 4,086 jobs created and retained. The help is free of charge to the small business.

Furgal and Meurer stay in touch and share information on advances in security. "It's a relationship that carries forward," Meurer says. "Our company has been enhanced by our involvement with NMSBA and Sandia."

One happy customer is the business owner whose motorcycles were being lifted from the storage yard. Armed Response put in an analytics system and a month later monitors got an alert, saw intruders, and dispatched guards. "We caught them," Meurer says. "The owner was doing handsprings. He said, 'This is it, finally.'"

A helping hand

If you'd like to learn more about the New Mexico Small Business Assistance Program, know a small business that might need help, or are a principal investigator who would like to offer technical assistance, visit nmsbaprogram.org. For a video of the Armed Response Team collaboration with Sandia, go to https://www.youtube.com/watch?v=PU6TVTZVcAA.

Take Our Daughters and Sons to Work Day

Photos by Randy Montoya

Last week more than 1,000 Sandians brought 1,693 kids to work to celebrate Take our Daughters and Sons to Work combined with Earth Day. Visitors observed or participated in 50 activities around the Labs and even some activities at Kirtland's Special Operations Wing.

Students enjoyed learning about Sandia's test capabilities at several locations, and visited venues where they learned about clean rooms, product development and packaging, high-performance computing, spacecraft design, information security and encryption, a 3-D journey through the brain, and mass measurements, to mention only a few of the activities that Sandians presented to show their sons, daughters, and other relatives about the wide range of work at Sandia.

"We couldn't plan such a great day without the support of those putting on the activities," says Pam Catanach of Community Involvement Dept. 3652, which coordinated the event. "Sharing a day in their work life, showing their kids what they do, and even seeing a part of the Labs they never see means a lot to our workforce."

Over the lunch hour on Hardin field, the kids got a chance to do lots of hands-on activities and have lunch with their parents and mentors. The Schiff Auditorium was full of informative Earth Day displays as well as a guest speaker.

Adelynn Padilla, daughter of Jason Padilla (6813) and granddaughter of Patty Zamora (3652), was thinking about becoming a lawyer when she arrived, but after visiting the Chemistry Workshop said, "Now I may become a scientist."

Sandia supports largest-ever CTBT inspection exercise

By Stephanie Holinka

At the end of last year, the nation of Alluvia, a signatory to the Comprehensive Nuclear-Test-Ban-Treaty (CTBT), alleged that the nation of Maridia performed an underground nuclear explosive test. Based on data collected by the Comprehensive Nuclear-Test-Ban Treaty Organization's (CTBTO) International Monitoring System, Alluvia demanded an on-site inspection (OSI) to determine if Maridia had in fact violated the terms of the treaty.

This fictional scenario was the basis of the Integrated Field Exercise 2014 (IFE14), the largest and most technologically advanced CTBT OSI exercise completed to date. The Preparatory Commission for the CTBO simulated an OSI of a clearly defined inspection area, exercising the personnel, equipment, and procedures that would be mobilized for an actual inspection, which could occur after CTBT enters into force.

The exercise scenario was fictional, but also technically credible and realistic, to put the inspection team through its paces.

Upon CTBT's entry into force, an OSI will become the final verification measure conducted for the international community to try to ascertain whether a nuclear explosion has taken place.

An OSI follows a series of clearly defined steps and timelines. During IFE14, the CTBTO exercised each phase of an OSI, starting with the receipt of the request, through mobilization of the inspection team to the inspection area, to the inspection process, and delivery of inspection results to the CTBTO's director general.

Julia Craven Jones (5772), the only American on the 12-person external evaluation team for IFE14, was responsible for examining the use of several technologies, which were used to inform the inspection team's search logic as part of the exercise.

"An important part of treaty verification is the on-site inspection. If there was a questionable event, a state signatory party could request that an on-site inspection be performed. Exercises like this help verify the operational capability of the organization to carry out a valid on-site inspection, should one ever be needed," Julia says.

The OSI process, including the integration of the permitted OSI technologies, is so complex that it took a team of experts nearly two years to develop the exercise scenario used for IFE14, but they needed to ensure that the exercise was technically valid.

"There's no point of showing up if there's not a scientifically credible back story," Julia says.

The 40-person inspection team included international experts in visual observation, seismology, geophysics, and radionuclide detection and analysis. The inspectors use increasingly intrusive techniques to gather evidence within the designated inspection area.

After inspection, the CTBTO's director general delivers an OSI findings report to the Executive Council of the Organization and the States Parties. Each of the CTBT member states can make its own determination, but the Executive Council "shall address any concerns as to whether any non-compliance with this Treaty has occurred," i.e., whether a nuclear explosion has taken place.

UNDER SECRETARY FOR ARMS CONTROL and International Security Rose E. Gottemoeller, right, visits with Julie Craven Jones (5772) at the Sandia FACT site, discussing technologies used in CTBT verification efforts. (Photo by Randy Montoya)

The evaluation team worked for nearly a year to develop its inspection evaluation approach.

"A lot of it came down to expertise, how the expertise applies to the specific activities and techniques that can be applied during an OSI, starting with less intrusive and moving to more intrusive techniques," Julia says.

Julia says the evaluation team created targets for each inspection activity and technique permitted by the treaty and "played" during the exercise, from calibration through final analysis and reporting.

"This has been a great experience because the world of CTBT experts is a tight-knit community, and Sandia had a unique opportunity to bring someone new into the team," Julia says.

New team members are needed in this area, both at Sandia and in the nonproliferation community.

"All of this effort is about detecting underground nuclear explosions. We need to take advantage of those experts in the Nuclear Weapons Complex before they retire, and also reach out to the next generation," says Mary Clare Stoddard (6831), manager of Sandia's Global Monitoring & Verification R&D Department.

Historically, Mary Clare says, people involved with this type of work at the Labs may have been involved in nuclear explosive testing, and many of those experts are retiring. She hopes Julia and others who follow her will be the next generation of CTBT nonproliferation researchers at Sandia.

She also says this area of work is challenging, and not just technically.

"I've worked in different parts of the Labs, and this is the most nuanced work I've done. Playing well with others — such as on this diverse, international exercise — is as or more important than driving to a technical solution. This is a people-dependent world," Mary Clare says.

Julia and the evaluation team are still working on finalizing the exercise report, a detailed, internal document that will include key findings with linked recommendations.

The work is funded by NNSA's Office of Nonproliferation and Arms Control (NA-24).

IFE14 INSPECTION TEAM members, including Julia Craven Jones, at their base camp during the exercise.

JULIA CRAVEN JONES and members of the IFE14 Inspection Team aboard a Royal Jordanian Air Force AS332 Super Puma helicopter that was used during the on-site inspection exercise.

Julia Craven Jones (5772), has been at Sandia for four years, but this isn't her first experience here. As a high school student, Julia participated in a NASA summer program that placed her at Sandia's Advanced Materials Lab.

"Albuquerque was a fond memory for me. After graduate school in Tucson, I came back out for a weekend and liked it," she says.

Julia's graduate research on infrared Fourier transform spectropolarimeter design and development was funded by NNSA's Defense Nuclear Nonproliferation Office of Research and Development (NA-22). During an annual review, she met several Sandians, including senior manager Toby Townsend, who convinced her to give Sandia a try. Julia's technical expertise in multispectral imaging opened the door on this opportunity to participate in IFE14.

Dana Powers elected a member of NAE for work on commercial reactor safety

By Heather Clark

A senior scientist and nuclear safety expert who studied the Three Mile Island and Chernobyl nuclear power plant accidents during his more than 40-year career at the Labs has been elected a member of the National Academy of Engineering (NAE).

Dana Powers (6220), who recently retired from Advanced Nuclear Energy Programs, was elected "for contributions to commercial nuclear power plant safety worldwide and to radioactive source-term processes," according to the NAE.

Dana is among 79 new members who will receive their diplomas during the induction ceremony at the NAE Annual Meeting in October. Election to the NAE is among the highest professional distinctions accorded to an engineer. Academy membership honors those who have made outstanding contributions to engineering research, practice, or education, including significant contributions to the engineering literature and to the pioneering of new and developing fields of technology, making major advancements in traditional fields of engineering, or developing or implementing innovative approaches to engineering education.

Dana received a bachelor's in chemistry and a doctorate in chemistry, chemical engineering, and economics from the California Institute of Technology. He researched the magnetic properties of basic iron compounds, catalyst characterization, and the rational pricing of innovative products.

His career has spanned a wide range of nuclear safety research from basic experimentation to implementing nuclear safety regulations. "My basic research is on the physics and chemistry, but Sandia is an engineering organization, and knowing the physics is not enough. You've got to know what you're going to do about it," he says. "You have to engineer systems to handle it, so I worry about engineering safety features and how they work. Because I'm on the Nuclear Regulatory Commission's Advisory Committee on Reactor Safeguards, I also think about how this gets implemented in the regulations."

Began career in chemistry, metallurgy

In 1974, Dana was about to accept a job with Bell Labs when Sandia invited him to New Mexico. Dana had lived in Grants, New Mexico, as a child and liked the state, and when he visited the Labs, he recalled liking the employees.

"The topics you work on come and go; the people you work with are really important, so I took the job here," he says.

Dana joined the Chemistry Metallurgy Division where he developed techniques for the hot pressing of metallothermic reaction mixtures and studied metallothermic reaction ignition.

Shortly after his arrival, the Nuclear Regulatory Commission (NRC) asked him to consult on metallurgy issues.

TMI accident held lessons for researchers

In those days, the NRC's research about severe accidents at nuclear power plants was speculative. "They didn't think they were a very high probability, but they wanted to know what would happen if you had one," Dana says. "Then along came Three Mile Island and suddenly nuclear accidents became very, very real."

After Three Mile Island (TMI) — a pressurized-water reactor in Pennsylvania that partially melted down in 1979 — Dana became heavily involved in researching chemical and metallurgical conditions at the plant. He was appointed a consultant to the President's Commission on the Accident at Three Mile Island.

Dana's research indicated that part of TMI's core had melted, but "people at the time absolutely rejected that notion, so we were in for a lot of criticism," he says. "The industry didn't think it was possible to melt the cores at the time. We were seeing the evidence and there was no other way to explain it."

About five years later, Dana was among those listening on an open telephone line as a fiber optic cable was lowered to inspect what was thought to be the core. As the cable was being lowered and the core was still not visible, the operators were so convinced that the core had remained intact that they explored whether the cable was kinked or the measurements were incorrect before finally realizing the reason the core wasn't seen was that it had partially melted, proving research supporting a partial meltdown was correct.

"TMI was a tremendous revolution and wake-up call to the industry. Even in the regulatory community we found out a lot about severe accidents that we had never imagined and learned a huge amount," Dana says. For example, researchers learned what evidence was important in a reactor failure, what to preserve, and where to look for answers, he says.

DANA POWERS

In 1981, Dana became supervisor of the Labs' Reactor Safety Research Division, which conducted analytic and experimental studies of severe reactor phenomena in fast reactors, as well as light-water reactors, the most common in the US today. The research helped the NRC and DOE better understand the effects of potential severe accidents in nuclear power plants and how to mitigate the risks.

The division tested a host of reactor fundamentals: hydrogen combustion, steam explosions, core-debris interactions with concrete, sodium interactions with structural materials, fission-product chemistry under reactor accident conditions, aerosol physics, and high temperature melt interactions with coolants.

"We were trying to understand how accidents progress. What can you do about them? Is there a way to stop them? If you can't stop an accident, can you mitigate its consequences?" he says.

In one video of a test, Dana showed a simulated reactor-core meltdown with a pressurized system and the resulting explosion (the test facility did not have a containment system), releasing what would have been radioactive aerosol were it a real nuclear accident, he says.

By time of Chernobyl accident, Sandia expertise known

The Chernobyl accident in Ukraine happened in 1986. By then, Sandia was known for its nuclear safety work and started getting phone calls almost immediately after the accident, Dana says.

The International Atomic Energy Agency established a Nuclear Safety Advisory Group on Chernobyl and Dana consulted with the Soviet researchers on the accident for the group. He also wrote a 10-year review of the radioactivity released in the accident.

From 1988-1991, Dana was a member of the then-DOE Advisory Committee for Nuclear Facility Safety, which later became the Defense Nuclear Facilities Safety Board. He was responsible for the development of safety research programs for DOE's nuclear facilities.

Three years later, he was appointed to the NRC's Advisory Committee on Reactor Safeguards. He served as chairman in 1999 and 2000, received a Distinguished Service Award in 2001, and will continue to serve until 2018.

Dana's experience has been tapped to teach newer Sandia employees in this field, says Peter Davies, director of Nuclear Energy & Fuel Cycle Programs (6200).

"Another dimension of Dana's enormous contribution to the world of reactor safety and to Sandia has been the time and energy he has invested in mentoring the next generation of Sandia researchers," Peter says. "He has coached, critiqued, challenged, and encouraged both staff and managers, stimulating them to move to greater levels of technical understanding and personal impact."

Working for so many years to improve nuclear power safety, Dana still seems fascinated with the subject. "Nuclear power is amazing; man's great discovery," he says. "It's a tremendous resource. It has all kinds of advantages, it doesn't matter what the weather is or whether it's day or night."

When it comes to safety, much progress has been made on nuclear power plants, he says.

"They are certainly vastly safer than what we had prior to TMI. There's no question about that. They run better and they operate more efficiently," he says.

Looking back, Dana says Sandia is a good place to stage a career. "You get the opportunity to work on things that no one's done very much on," he says. "It's always best when there are not a lot of footprints in the snow, doing things for the first time, developing techniques on things that on the face of it look impossible to do. We get to do that a lot at Sandia."

Science Bowl teams head to nationals

THIS WEEKEND, Albuquerque Academy's middle and high school teams will compete in DOE's National Science Bowl in Washington, D.C. The lively question-and-answer tournament tests students' science and math knowledge. Coached by former Sandian Jason Zuffranieri (pictured above with the middle school team), the two teams earned an all-expense-paid trip to the national competition after triumphing at the recent New Mexico Regional Science Bowl events. Zuffranieri, now on the math faculty at Albuquerque Academy, has coached the teams since September 2014. He says preparing for the Science Bowl helps "reinforce the interesting nature of how much different science there is." Sandia coordinates the New Mexico Regional Science Bowl for the DOE Office of Science, and more than 50 Sandians volunteered to support the regional middle and high school events. (Photo by Amy Tapia)

Order of the Nucleus honors Sandians' nuclear weapons work

US AIR FORCE NUCLEAR WEAPONS CENTER commander Maj. Gen. Sandra Finan presents Order of the Nucleus awards to retired Sandian Harold Rarrick (left photo), Jerry McDowell, (center) who served as Sandia's Executive VP for National Security Programs for several years before announcing his retirement effective in July, and Bruce Walker, who retired last year after serving as Div. 2000 VP and Sandia's chief weapons engineer since 2011. The order recognizes those who have made significant contributions to the US nuclear enterprise and the nation's defense, particularly in collaboration with the US Air Force.

By Sue Major Holmes

Three Sandians have been awarded the 2014 Order of the Nucleus for their nuclear weapons work, joining a list of scientists, engineers, military officials and others recognized since the Air Force Nuclear Weapons Center (AFNWC) established the award in 2011.

The honorees are Jerry L. McDowell, former Deputy Labs Director and Executive Vice President for National Security Programs, soon to be retired; Bruce Walker, retired Sandia Vice President of Weapons Engineering and Product Realization and chief engineer; and Harold Rarrick, who retired after a long career in weapons effects and nuclear testing and 15 years as a senior mentor for Sandia's Weapons Intern Program. They were honored in a special ceremony at the National Museum of Nuclear Science and History in January. Jerry, who was unable to attend in January, received his award in March.

A plaque displayed at the entrance to the Air Force Nuclear Weapons Center lists honorees, who receive a certificate and a specially designed numbered coin. The center created the order to recognize those who have made significant contributions to the US nuclear enterprise and the nation's defense, particularly in collaboration with the US Air Force. Recipients have included Air Force officers and non-commissioned officers, national laboratories scientists and engineers, community leaders, and civilian officials of the National Nuclear Security Administration, the Air Force, and the Navy. AFNWC senior leaders make nominations for the award each year.

Without the kind of dedication shown by Order of the Nucleus recipients, "we would not enjoy the freedom and safety we do today," the center's commander, Maj. Gen. Sandra Finan, said at the January ceremony.

"Essentially deterrence is making an adversary or potential adversary think really hard before taking hostile action against us or our allies because they believe we will invoke unacceptable consequences in return," she said. "Many think of it as political, something far away, something we study or read about, something not really real, but I will tell you we do deterrence every day."

The order honors people who make deterrence work, "from the community support we receive to the scientists and engineers who keep the weapons reliable to the operators and maintainers who stand ready to employ them if the order is ever received from the president," the general said.

Some 61 individuals and three groups have received the award in its four-year history. The very first recipient was Leon Smith, whose Sandia career spanned 41 years. During World War II, he joined the 509th Composite Group and helped set up an electrical lab to develop, assemble, and test fuzing systems for the project that developed the first atomic bomb. In 1947, he joined Los Alamos lab's Z Division, which became Sandia. He died in 2012 at age 92.

Other past Sandia recipients include:

- John C. Hogan, a retired senior scientist and lead instructor for Sandia's weapon training programs. He taught more than 6,000 DoD and DOE personnel about nuclear weapons;
- Caroline Hart, who ended her 33-year career as Vice President of Weapons Engineering and Product Realization and chief engineer after devoting much of her efforts to the reliability, safety, and security of the nuclear weapons stockpile; and
- Bill Patterson, one of the original researchers in Sandia's earth-penetration weapons program, who became a senior mentor for Sandia's Weapon Intern Program after his retirement.

The Air Force recognition is evidence of the vital collaboration between the military and Sandia in support of the US nuclear deterrent, Jerry says. "This is indeed a great honor and deeply appreciated since the partnership between Sandia and the Air Force is critical to our collective ability to ensure the nuclear stockpile remains safe, secure, and effective. We are privileged to have the Air Force Nuclear Weapons Center across the street where the leadership and staff can interact daily," he says.

Volunteer breakfast

By Stephanie Holinka

At the annual Sandia Serves Volunteer Breakfast on April 14, Sandia honored the many employees who donate their time and talents to better the community. Approximately 250 volunteers attended the event.

Sandia President and Labs Director Paul Hommert thanked the volunteers for their contributions to the community.

"This giving that we are honoring today is an important part of our fabric. Our employees contributed over $6.5 million through United Way and over $14,000 to Shoes for Kids," Paul said in the event's opening remarks.

Paul noted that more than a thousand members of the workforce reported 92,000 volunteer hours in 2014, and more than 250 volunteers participated in last year's Make a Difference Day.

Lockheed Martin Corporation, on behalf of Sandia, donates more than $1.4 million annually to nonprofit organizations in support of science, technology, engineering, and math (STEM) education, supporting veterans, and helping our neighbors with their basic human needs. Lockheed Martin encourages volunteerism and set a goal this year of "A Million Makes a Difference." Sandia was an important contributor to Lockheed's goal of reporting one million volunteer hours.

"Sandia serves in the national interest, and in our local community. The breakfast recognizes the volunteer work done by employees throughout the year," says Amy Tapia, manager of Community Involvement Dept. 3652.

MORE THAN 250 Sandians participated in Make a Difference Day 2014. Here, volunteers help with a project at the National Museum of Nuclear Science and History. (Photo by Patty Zamora)

Amy also called out the extra effort of Sandia's mail services and transportation employees, who help with logistics on many of the donation and giving efforts at the Labs.

Additionally, 302 employees volunteered 100 or more hours to receive the President's Volunteer Service Award, which recognizes individuals who have volunteered more than 100 hours over a 12-month period.

The President's Council on Service and Civic Participation created the President's Volunteer Service Award program as a way to thank and honor Americans who, by their demonstrated commitment and example, inspire others to engage in volunteer service.

Mission Graduate

At the Volunteer breakfast Amy Tapia, manager of Community Involvement Dept. 3652, presented a check for $20,000 to Mission Graduate Executive Director Angelo Gonzales in recognition of the employees who logged their volunteer hours this year.

"This is kind of like coming home for me. I worked at Sandia for five summers as an intern. My parents both retired from Sandia, so I am very familiar with Sandia," Gonzales says.

Gonzales described the work of Mission Graduate, a cradle-to-career education partnership in central New Mexico, which includes Bernalillo, Sandoval, Torrance, and Valencia counties.

Gonzales discussed the partners' commitment to the goal of adding 60,000 new college degrees and certificates to central New Mexico by 2020, which will ultimately enrich the community and attract new talent and business to the state.

"We want to make sure that every one of our kids can excel and succeed from early childhood education through high school. We want to make sure that all of our children have the opportunity to go to college and earn a certificate or degree. And we want to make sure that every one of our graduates can enter the career of their choice, right here in central New Mexico."

Gonzales says that ultimately Mission Graduate seeks to close the opportunity gaps for students in central New Mexico, which moves them and the state forward.

One way Sandia supports efforts like Mission Graduate is the nearly 2,600 career exploration activities offered annually, including student intern opportunities. Amy is the chair of the Mission Graduate STEM Council.

David Williams (0100) represents Sandia in Mission Graduate's Employment Network. David works with other companies interested in supporting students in the transition between academic and professional work.

Sandia Classified Ads

Due to the Memorial Day Holiday, the deadline to submit a Classified Ad for the May 29 *Lab News* will be noon, Thursday, May 21 not Friday, May 22. This change applies to the May 29 paper only.

MISCELLANEOUS

CORNER KITCHEN CABINET, new, Lazy Susan, unfinished, never installed, works perfectly. $100. Rockwell, 505-250-3737.

PIANO, Baldwin Acrosonic, beautiful mahogany cabinet, excellent condition, regular tunings, nice touch, $800 OBO. Lee, 856-0789.

MODEL I TRS80, free to vintage PC enthusiast, monitor, keyboard, expansion module, floppy disk drives, manuals. Breiland, 505-884-8438.

FILL DIRT, you pick up, free. Reeder, 553-4786.

STEER, ready for freezer, farm-raised, can arrange & deliver to processor, $3.20/per lb. market price. Metzler, 565-2033.

CEMENT MIXER, 3-1/2-cu. ft., Harbor Freight, unopened, $100; Quikrete 6921-34 Walk Makers, never used, 2, $15 ea. Madsen, 610-0725.

FITNESS TREADMILL, permanent incline, great for hill training, will deliver, good condition, $300. Seaborn, 453-6744.

POP-UP THRIFT SHOP, benefits Junior League of Albuquerque, May 2, 8 a.m.-1 p.m., 3900 Osuna Rd. NE, 87109 (Adelante Bldg.). Silva, 505-450-1383.

BEDROOM SET, king, black, w/dresser, 2 nightstands, headboard more, $400 OBO; queen set, w/dresser, nightstand, more, $700; Serta queen, w/box springs, $300. Caldwell, 859-358-4553.

BEDROOM SET, queen, dresser & shadowbox mirror, Early American, medium finish, mattress/frame not included, $100. Roesch, 281-9751.

RECHARGEABLE TOOTHBRUSH, Philips Sonicare, 2 series, in original box, never used, $25. Wagner, 505-504-8783.

INK CARTRIDGES, Canon PIXMA, one 8BK, one 8Y, one 8C, $15/all. Goy, 505-410-0514.

POOL TABLE, Olhausen, 9-ft. regulation, excellent shape, $1,200 firm. Marquez, 899-0629.

LOOM, 46-in. 8 Harness, Gilmore, w/bench, excellent condition, $3,902 new, asking $1,900. Berg, 884-5229, dickberg01@aol.com.

CRIB, Baby Europa Palisades, dark cherry wood, nearly new, w/mattress, $200 OBO. Ortega, 505-362-9515.

ANTIQUE REED PUMP ORGAN, needs some work, $125. Drebing, 999-9813.

TOW BAR, used 3 times; electrical harness, cables etc; RV vacuum cleaner, $45; lanterns, oil & battery; aluminum ladder; many RV items. Garcia, 554-2690.

DINING TABLE, Southwestern, wooden, whitewash finish, w/matching hand-upholstered, cushioned chairs, $349 OBO. Moonka, 505-307-4879.

TABLET, Verizon Ellipsis, 7.7-in. screen, 8GB + 32GB SD, free, just take over contract of $10/mo. Lindsay, 507-5525.

STEREO SPEAKERS, 2 Bang Olufsen 3700, 2 Bang Olufsen, $35; no plugs; 2 Ampex 517, $125. Walkington, 831-6974.

LEATHER JACKET, Alpinestars GP-R, perforated, size 42, white/black, photos at www.smughug.com/gallery/n-hvZWG, new, $250. Yazzie, 505-449-8086.

PUSH MOWER, Friskars Momentum, 3 yrs. old, good condition, new $190, asking $75. Brethauer, 505-463-7016, ask for Rick.

GUITAR, Gibson CL-35, acoustic cutaway, pristine condition, $1,800. Fincke, 294-3927.

SHOPSMITH 510, w/PowerPro upgrade motor, band saw, accessories, good condition, $1,100. Tran, 797-2041.

NEW MEXICHORDS BARBERSHOP CONCERT, "A Lifetime Together", May 15-16, call for more info & tickets. Taylor, 323-6435.

CHAMPION COOLER, model ADATD-12, 1.3-hp, downdraft, good condition, $100; Medline rolling walker, w/seat, new, $60. Graham, 293-7302.

How to submit classified ads

DEADLINE: Friday noon before week of publication unless changed by holiday. Submit by one of these methods:

- **EMAIL: Michelle Fleming (classads@sandia.gov)**
- **FAX: 844-0645**
- **MAIL: MS 1468 (Dept. 3651)**
- **INTERNAL WEB: On internal web homepage, click on News Center, then on *Lab News* link, and then on the very top of *Lab News* homepage "Submit a Classified Ad." If you have questions, call Michelle at 844-4902. Because of space constraints, ads will be printed on a first-come basis.**

Ad rules

1. Limit 18 words, including last name and home phone (If you include a web or e-mail address, it will count as two or three words, depending on length of the address.)
2. Include organization and full name with the ad submission.
3. Submit ad in writing. No phone-ins.
4. Type or print ad legibly; use accepted abbreviations.
5. One ad per issue.
6. We will not run the same ad more than twice.
7. No "for rent" ads except for employees on temporary assignment.
8. No commercial ads.
9. For active Sandia members of the workforce, retired Sandians, and DOE employees.
10. Housing listed for sale is available without regard to race, creed, color, or national origin.
11. Work Wanted ads limited to student-aged children of employees.
12. We reserve the right not to publish any ad that may be considered offensive or in bad taste.

FURNITURE; dining set; china hutch; upholstered chairs; computer/media cabinet; trundle bed; all excellent condition, moving, must sell. Nichols, 505-239-6842.

TRANSPORTATION

'78 CHEVY K20, 3/4-ton, 4x4, truck, 73K original miles, runs great, manual transmission, $4,400 OBO. Martin, 623-687-7673.

'85 HONDA CRX, project car, manual transmission, 310K miles, needs work, $1,300 OBO. Mora, 291-1250.

'06 C6 CORVETTE CONVERTIBLE, 400-hp, V8, 6-spd., AT, 10K miles, 1 owner, red, immaculate condition, $32,000. Mattie, 505-332-8527.

'82 GMC JIMMY, Warn winch, all power, tow pkg., very low miles, call or text. Hanks, 249-1931.

'12 TACOMA, navy blue, 6-spd. MT, TRD OR, 30K miles, asking NADA value, need to buy a house. Valerio, 505-331-7042.

'10 NISSAN TITAN PRO4X, 35-in. tires, custom lift, 75K miles, $25,000 OBO. Kreitinger, 406-939-2334.

'10 CHRYSLER 300 LIMITED, fully loaded, leather seats, sun roof, inferno red interior, 75K miles, great condition, $16,400. Vigil, 999-7566, ask for Jared.

RECREATION

'10 AEROLITE ZOOM TRAVEL TRAILER, 23-ft., new tires, 1 owner, very good condition, $14,500. Anderson, 505-459-7781, Maj910@aol.com.

'04 TERRY QUANTUM 5TH WHEEL, bunk house, 1 slide, 2 axles, stored on base, $9,000 OBO. Patton, 379-3287.

'95 HARLEY-DAVIDSON SPORTSTER 1200 EVOLUTION, low mileage, ~3.6K, garage-kept, excellent condition, $3,900 firm. Frakes, 505-363-1883.

BICYCLE, 685mm xc carbon handle bars, $40; 29er Mavic wheels, $375. Roberts, 275-2941.

SCOOTER, JmStar, 150cc, 7K miles, luggage carrier, garaged, well-maintained, $699 OBO. Brosseau, 238-5175.

WOMEN'S BIKE, SM frame, Timberline GT, 21 gr., ridden twice, w/helmet, car rack, accessory bag, $400. Washburn, 505-259-9409.

BOY'S BIKE, new, 26-in. street model, has everything, 7-spd., $150. Hill, 205-1496.

REAL ESTATE

4-BDR. HOME, 2 baths, 2,093-sq. ft., never lived in, must sell, NW, $255,000, 3% discount w/o realtor. Sanchez, 505-515-5997.

4-BDR. HOME, 3 baths, 3-car garage, 4,000-sq. ft., refrigerated air, private 0.4 acres, near Sandia Labs. Dybwad, 270-5888.

3-BDR. HOME, 2 baths, 1,575-sq. ft., renovated, $165,000. Buck, 353-2667.

4-BDR. HOME, 2 baths, 2,500-sq. ft., 3 patios, 2-car garage, Monte Vista neighborhood, $435,000. Jones, 218-1147, ask for Robert.

3-BDR. TOWNHOUSE, 2 baths, 1-story, 2-car garage, 1,850-sq. ft., NE Heights. Spray, 505-385-2442.

2 WOODED ACRES, Woodlands at Sedillo Hill, flat lot, all utilities underground, paved roads, great views, 20 mins. to SNL, $140,000. Duncan, 835-4243.

WANTED

PRIVATE ROOM, w/bath, for new MOW, near Albuquerque for Mon.-Fri., month-to-month arrangement preferred. Paoletta, 505-401-9621.

DOG SITTER, for Golden Retriever, 8 yrs. old, July 2-11, either at my house or other residence, great w/kids & nonaggressive dogs, $20/day. Melkey, 319-538-6152.

ROOMMATE, 11 mins. from base, $750/mo., utilities, Wi-Fi, covered parking included. Wolfe, 505-235-3488.

SOMEONE FLUENT IN POLISH, to interpret occasional handwritten letters/greeting cards from family in Poland. Kovarik, 918-3577.

RETIREES INTERESTED IN TECHNOLOGY-BASED ECONOMIC DEVELOPMENT, your ideas & talents are valuable. Tatro, 505-281-9285.

RAPTOR, e.g. hawk, falcon, etc., for good home at National Museum of Nuclear Science and History. Hanks, 977-3372.

MOVING BOXES, used. Stermer, 299-1159.

WORK WANTED

PRIVATE SWIMMING LESSONS, for children 7-15 (including physically challenged), experienced lifeguard, taught at Albuquerque Academy. Thai, 505-480-7721.

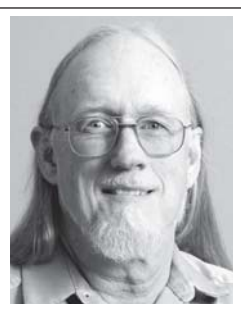
Mileposts

New Mexico *photos by Michelle Fleming*

Joseph Costales
35 10261

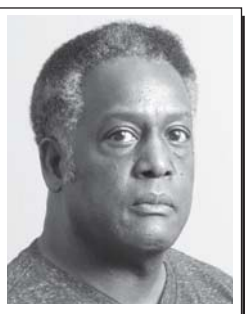
Recent Retirees

Retiring and not seen in the *Lab News* pictures:
Linda Konkel (3658), 24 years.



Victor Yarberry
39 1719

Anthony Thornton
34 5020



Tap Taplin
31 2665

Peggy Clews
25 1746

Carl Vanecek
25 2610

Dominic Martinez
25 6835

Angela Campos
30 9524

Anna Trujillo
30 10625

Jo Cunningham
25 1101

Noel Thomas
5 1747

Jeffrey Smith
20 1555

Annette Aranda
15 3300

Nicolette Bauer
15 10629

Michael McReaken
15 2614

Devan Myers
15 2663

Recycle the *Lab News*

The *Sandia Lab News* is printed on 75 percent recycled content paper. Please recycle them in the yellow mixed paper bins.

Triumph of the spirit

Sandia lends a hand to kids who conquered adversity to earn a diploma

TWENTY HIGH SCHOOL SENIORS who overcame adversity on the road to graduation each received an educational award of $1,500 from Sandia and Lockheed Martin Corp. The students said in remarks at an April 22 ceremony that the award will help them reach their goals. Frederick Bermudez, front row right, acting director of Public Relations and Communications Center 3600, was the event emcee. Kim Sawyer, far left, deputy Laboratories director and executive vice president for Mission Support, was the speaker. (Photo by Norman Johnson)

By Nancy Salem

Life changed for Isaiah Wright-Wiggins at age 13. The tight bond he had with his mother came loose when she left an abusive relationship for one more stable. "I thought it was a good thing that we were getting away from a bad situation," Isaiah says. "But there wasn't room for me in the new family. That relationship drove a wedge between me and my mom, and I felt neglected and alone."

Thus began several years of instability for the teen, who moved between the households of his father, mother, and grandmother, never staying long at any one place. "My life was not in any way conventional because my parents never lived together," Isaiah says. "But it was a tough transition to leap from house to house and accept the new reality with my mom. It was hard to balance that with school work."

UNDAUNTED COURAGE — From left, Isaiah Wright-Wiggins, Deven Peace, and Cassady Leonard faced challenges ranging from homelessness to mental illness. All three found the courage to move forward and graduate from high school. (Photo by Norman Johnson)

Cassady Leonard faced a different challenge. Drug addiction in her family left her depressed and anxious. "I had mental health issues that I didn't handle in a healthy way," Cassady says. "I tried to deal with it myself but didn't do it appropriately."

Cassady ran away during her sophomore year of high school and was homeless for a while. "It was a big struggle," she says.

Deven Peace also faced homelessness when his family was evicted from their house the summer before his senior year. Not long after, he watched as his younger brother was injured in a random shooting at a park. "It seemed like everything that could go wrong went wrong," Deven says. "It was hard."

Isaiah, Cassady, and Deven persevered and are now headed to college. Isaiah pulled away from his parents and got the support he needed from his grandmother. Inspired by his experiences to reach for a better life through higher education, he graduated from Bernalillo High with a 4.0 grade point average and was accepted to the University of Denver. Cassady got into therapy and turned her life around. She graduated from Freedom High and will attend the University of New Mexico this fall. And Deven, whose family got back into a house, joined the basketball program at Atrisco Heritage Academy and found the focus to graduate and aim for college, possibly New Mexico Highlands.

They are among this year's 20 Thunderbird Award winners who each received $1,500 from Sandia and Lockheed Martin Corp. in recognition of their exceptional ability to overcome significant personal challenges on the path to high school graduation.

"It has been said that adversity builds character," Kim Sawyer, deputy Laboratories director and executive vice president for Mission Support, told honorees at the 21st annual awards ceremony on April 22. "The achievements of this exceptional group of young men and women demonstrate that."

Stories of courage

Family, friends, school principals, advisers, and mentors of the winners attended the ceremony at the Sheraton Uptown. Also on hand were Albuquerque Mayor Richard Berry, representatives of the New Mexico congressional delegation, members of the Albuquerque Public Schools board, then-acting APS Superintendent Brad Winter, Superintendent Sue Cleveland of Rio Rancho Public Schools, and Juliette Romero Benavidez, assistant superintendent of curriculum and instruction at Los Lunas Schools.

The stories were filled with examples of courage. There was Paul, who was born legally blind and was severely bullied before finding a calling in music. Natasha cared for her dying mother while trying to keep up in school. Hidayatulla, a Pakistani refugee, struggled to learn English while supporting his single mom and six siblings working nights and weekends at a fast-food restaurant.

"It is impossible not to be touched deeply by these young people," said event emcee Frederick Bermudez, acting director of Public Relations and Communications Center 3600. "They are amazing role models to anyone who has faced a challenge. They have gone through the hardest part of their lives and found the determination to move forward."

The road to higher education

Each of the honorees is headed to college with a career goal. Majors range from sociology to education to medicine.

Isaiah says he will major in accounting and business management, and hopes to earn a master's in business administration. "The problems I faced ended up motivating me and not holding me back," he says. "I knew I had to do well in school." He says the Thunderbird Award will help him transition to college. "I was ecstatic," he says. "It is an incredible honor."

Cassady plans to major in psychology and sign language in hopes of being a therapist for deaf children. "If you help someone when they are young it will have an impact down the road," she says. "I want to give deaf children a voice and someone to talk to." She says the Thunderbird Award is exciting. "It will help me with my education," she says. "It takes a lot of stress off."

Deven wants to go into sports medicine. "Basketball helped me recover," he says. "The Thunderbird Award will help too, a lot."

Kim said Sandia wishes all the recipients continued success in life. "Sandia and Lockheed Martin are honored to invest in your education and future," she said. "You are an inspiration to everyone here."